# The impact of various staining substances and immersion time on the stainability of bonded sapphire brackets with three kinds of light cure orthodontic adhesives (An *in-vitro* study)

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## ABSTRACT

**Background:** The need of the patient for a more reasonable esthetic orthodontic intervention has risen nowadays. Thus, orthodontists make use of esthetic orthodontic materials like brackets, ligature elastics, and arch wires. The esthetic brackets come as different forms of materials, such as ceramic brackets, which have their stainability remaining as the most important consideration for the patients and the orthodontists. This study aimed to compare the staining effects of various staining materials, including black tea, cigarette smoke and Pepsi, as well as the time effect on the color stability of sapphire ceramic brackets bonded with three kinds of light cure orthodontic adhesives: Transbond, Resilience and Enlight.

**Materials and Methods:** Three hundred sixty sapphire brackets were utilized and divided into three different groups (120 brackets per group) based on the type of bonding material. Each group was further subdivided into four subgroups (30 brackets each) based on the media in which the brackets were fully immersed, including distilled water, black tea, cigarette smoke and Pepsi. Moreover, each of these subgroups were further subdivided, based on the time of immersion relative to each media, into 3 different smaller subgroups (10 brackets each): one day, 7 days and 14 days with incubation at 37°C. A UV-visible type of spectrophotometer was utilized in order to perform a light absorption test. ANOVA and post hoc LSD tests were used for comparison.

**Results:** The smoke of cigarette appeared to be the highest potent staining type among the tested materials followed by Pepsi and tea. The staining effects of all kinds of staining materials in relation to the bonded brackets color with all adhesive types were raised with increased time of immersion.

**Conclusion:** The patient's cooperation and habits should be taken into consideration when using sapphire orthodontic brackets. In addition, the patients should be instructed to decrease the consumption of staining beverages.

**Keywords:** Stainability, staining materials, sapphire brackets. **(Received: 2/7/2019; Accepted: 25/8/2019).**

## INTRODUCTION

The kind of esthetic part relative to orthodontic therapy is turning out to be more crucial; thus to enhance esthetics along the treatment, ceramic brackets have been widely used [(1,2)].

Generally, ceramic brackets are made of aluminum oxide. There are two different kinds of these brackets: the monocrystalline alumina (sapphire) brackets and polycrystalline alumina (ceramic) brackets. Sapphire brackets are basically milled directly from one crystal of sapphire by the use of the tools of diamond. The polycrystalline alumina tends to bind thermally to ensure that the particles are fused together [(3-6)].

The most vital factor in a successful esthetic treatment is regarded as the stability of the color of the esthetic materials utilized. The stainability of the ceramic brackets is of a multifactorial origin (intrinsic and extrinsic factors) [(7)].

The intrinsic discoloration may be the result of inadequate polymerization of adhesives or resins, water absorption, the type of the material's matrix, the size and content of the material particles [(7,9)], brand, [(10)] and tone [(11)]. The extrinsic discoloration may be the result of subject's saliva [(12)], consumption of food containing caffeine (coffee, tea, Pepsi), use of mouth rinse, nicotine [(13)], heat [(14)] and lipsticks [(15)].

The most frequently consumed materials by Iraqi people are tea, Pepsi, and cigarette. Thus, it is vital to know the impact of these materials in relation to color stability of sapphire brackets.

## MATERIALS AND METHODS

Three hundred sixty Roth type maxillary right central incisors sapphire brackets (PERFECT CLEAR, Hubit Company, Korea) were utilized in this study.

Three kinds of light cure orthodontic adhesives namely: Transbond XT$^{TM}$ (3M Unitek/USA), the Enlight (Ormco/Italy) and Resilience ® (Orthotechnlogy, USA) were used to bond the brackets.

Black tea (Ahmad Tea, England), Pepsi cola (Baghdad Company, Iraq) and cigarette (Gauloises Blonde, the European Union) as well as distilled

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water as control media were used as the major staining materials.

**Sample Organization**

The brackets were divided based on the kind of bonding materials into three equal groups; 120 brackets in each: bonded with Enlight, Transbond XT™ and Resilience ® orthodontic adhesives.

Each group was further subdivided into four subgroups based on the staining media (30 brackets for each); the distilled water that served as control group, the black tea, Pepsi and the cigarette smoke. In each subgroup, the brackets were subdivided again based on the immersion durations into 1 day, 7 days and 14 days with 10 brackets for each period.

**Bonding Process**

A thin coat of the primer was put in one direction on each bracket base surface using small type of brush. A particular small quantity of the adhesive paste was placed onto the base of the bracket and placed lightly onto a slide of the glass with the use of the bracket holder.

The glass slide was mounted directly on the surveyor table (Dentaurum, Germany), then covered with a celluloid strip, which enables easy separation of the entire bracket adhesive complex.

After that, each bracket was subjected to a constant load using 200 gm load fixed on the upper part of the surveyor's for about 10 seconds just to make sure that the brackets were seated directly under an equivalent force as well as to make sure an equal adhesive thickness is obtained. At that point, the adhesive material excess was taken away from the bracket base area with the use of an explorer without any movement for the seated bracket, then a particular light curing unit (the Blue LEX LD-109 from Taiwan) was used for the photopolymerization of the adhesives for about 5, 10, 20 seconds for the Transbond XT™, Enlight and the Resilience ® adhesives pastes, respectively according to manufacturer instructions.

**Smoke Chamber**

A plastic container was used as a smoke chamber with the use of a rubber tube that is suitable for the cigarette to ensure an equal smoke distribution and exit directly with the use of a portable suction device, known as saliva ejector (HOO3-C, China). The saliva ejector was suitable for creating a negative pressure in order for the smoke to aspirate from the cigarettes, consequently resulting into the impregnation of all of the brackets relative to the materials, which is then contained directly in the smoke, so as to further reproduce *in vitro* to the oral cavity of the smoker.

Meanwhile, for matching coverage with respect to the entire brackets to the smoke of the cigarette, the brackets were carefully fixed directly alongside the ligature wires of the stainless steel and placed inside of a chamber, ensuring they are tightened to a stainless steel holder acting as a support that would permit the brackets to remain in similar vertical level, in order for most of the surface part to be exposed to the smoke of the cigarette.

**Staining Procedure**

Making the staining solutions

- The Tea: By dipping 5 tea bags directly in 500 ml of distilled water that is boiling for about 10 minutes.
- Pepsi: For each day, Pepsi new cans were utilized.

**Soaking through staining solutions**

All of the brackets were positioned in a solution inside of a static plastic container and then labeled using sticky labels, and stored in the incubator at 37°C. All the staining solutions were changed daily. The entire storage duration was 14 days.

- The Cigarette: Twenty sticks of cigarettes were made use of on a daily basis and each of the cigarettes was burned off in a regular time of about 10 minutes in an entire duration of about 14 days. After every 20 sticks of cigarettes are burned, the brackets were then washed with the use of ultrasonic cleaner (VGT-1740QT, China) made for the removal of the remaining smoke substances present in the surfaces of the brackets, then placed back to the container containing the distilled water and further kept in the incubator (Memmert from Germany) at the temperature of 37°C, until another time of smoke exposure.

**Spectrophotometric Analysis**

The spectrophotometer, known as the UV-Visible Spectrophotometer (Shimadzu, UV-1800, Japan), was utilized to perform the readings of color changes, with the range of wavelength of about 380 and 780 ηm with two analytical beam handles. Also, a black type of rectangular cardboard piece with a specification of 40×15×0.2 mm alongside a hole located around 1.7 mm directly from the base, was utilized to permit the brackets' standard arrangement during the color readings.

Prior to the readings, each bracket was removed from the staining solutions as well as cleaned for one minute by the ultrasonic cleaner and dried on paper towels [16-18]. The spectrophotometer was calibrated before the color readings when the chamber was opened and the two black cardboards were fixed (without any hole) to the two analytical

beam handles. At this point, the chamber was further shut and the spectrophotometer gave an auto zero order.

The impact of the black type of cardboard was excluded, then the spectrophotometer's chamber was further opened and at this point, the bracket was positioned in a similar particular upright position alongside the black type of cardboard as indicated in figure 1. The chamber was then closed, then the spectrophotometer started to perform the process of scanning, starting from about 800ηm measure of wavelength present in the infrared region to 200ηm measure of wavelength present in the UV region moving across the entire spectrum relating to visible light.

Meanwhile, the light absorption readings were gotten in the form of a graph from which the quantity of absorbed light relative to a particular measure of the wavelength of about 345ηm can be obtained and used directly within the statistical analysis.



**Figure 1: The bracket was positioned on the analytical beam handle of the spectrophotometer and the blank on the other analytical beam handle.**

**Statistical Analyses**

The results were analyzed with the use of the "Statistical Package of Social Science" represented by SPSS version 15 application software alongside Windows XP operating system Chicago, USA. The statistics used within this study included:

1. Descriptive statistic: means, standard deviations, minimum and maximum values.
2. Inferential statistics: One way analysis of variance was used to assess any significant difference among groups followed by LSD test to test any statistical critical difference between each two groups.

In the statistical evaluation, significance was considered at $p<0.05$

## RESULTS

The brackets' quantity of light absorption immersed in different staining materials is shown in tables 1 and 2. In all types of adhesives, cigarette smoke was the most potent staining agent followed by tea and Pepsi with a significant difference.

The quantity of light absorption of the brackets immersed in different staining materials at different time intervals is shown in tables 3 and 4. The staining effect of all agents, except distilled water, increased with increasing time of immersion.

**Table 1: Descriptive statistics of light absorption and media difference in each duration for the brackets bonded with Enlight, Resilience and Transbond adhesives.**

| Adhesives | Duration | Media | Descriptive statistics | | | | Media Difference (d.f.=39) | |
|---|---|---|---|---|---|---|---|---|
| | | | Mean | S.D. | Min. | Max. | F-test | p-value |
| Resilience | 1 day | D.W. | 0.35 | 0.0007 | 0.349 | 0.351 | 1337.071 | 0.000 |
| | | Pepsi | 0.349 | 0.0011 | 0.348 | 0.351 | | |
| | | Tea | 0.365 | 0.0009 | 0.364 | 0.367 | | |
| | | Cigarette smoke | 0.371 | 0.0010 | 0.369 | 0.372 | | |
| | 7 days | D.W. | 0.351 | 0.0014 | 0.35 | 0.353 | 1691.500 | 0.000 |
| | | Pepsi | 0.356 | 0.0014 | 0.355 | 0.359 | | |
| | | Tea | 0.372 | 0.0015 | 0.37 | 0.374 | | |
| | | Cigarette smoke | 0.391 | 0.0011 | 0.39 | 0.393 | | |
| | 14 days | D.W. | 0.351 | 0.0014 | 0.35 | 0.353 | 3771.330 | 0.000 |
| | | Pepsi | 0.360 | 0.0008 | 0.359 | 0.362 | | |
| | | Tea | 0.379 | 0.0012 | 0.378 | 0.381 | | |
| | | Cigarette smoke | 0.401 | 0.0010 | 0.399 | 0.402 | | |
| Enlight | 1 day | D.W. | 0.354 | 0.0008 | 0.353 | 0.355 | 354.234 | 0.000 |
| | | Pepsi | 0.354 | 0.0010 | 0.352 | 0.355 | | |
| | | Tea | 0.358 | 0.0007 | 0.357 | 0.359 | | |
| | | Cigarette smoke | 0.365 | 0.0008 | 0.364 | 0.366 | | |
| | 7 days | D.W. | 0.355 | 0.0006 | 0.354 | 0.356 | 1415.478 | 0.000 |
| | | Pepsi | 0.356 | 0.0007 | 0.355 | 0.357 | | |
| | | Tea | 0.363 | 0.0010 | 0.361 | 0.364 | | |
| | | Cigarette smoke | 0.376 | 0.0008 | 0.375 | 0.377 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Transbond | 14 days | D.W. | 0.355 | 0.0006 | 0.354 | 0.356 | 1968.508 | 0.000 |
| | | Pepsi | 0.357 | 0.0008 | 0.356 | 0.358 | | |
| | | Tea | 0.370 | 0.0012 | 0.369 | 0.372 | | |
| | | Cigarette smoke | 0.381 | 0.0007 | 0.38 | 0.382 | | |
| | 1 day | D.W. | 0.335 | 0.0006 | 0.334 | 0.336 | 519.821 | 0.000 |
| | | Pepsi | 0.334 | 0.0016 | 0.332 | 0.336 | | |
| | | Tea | 0.340 | 0.0006 | 0.339 | 0.341 | | |
| | | Cigarette smoke | 0.351 | 0.0011 | 0.349 | 0.352 | | |
| | 7 days | D.W. | 0.335 | 0.0006 | 0.334 | 0.336 | 2248.279 | 0.000 |
| | | Pepsi | 0.338 | 0.0013 | 0.335 | 0.339 | | |
| | | Tea | 0.346 | 0.0007 | 0.345 | 0.347 | | |
| | | Cigarette smoke | 0.363 | 0.0006 | 0.362 | 0.364 | | |
| | 14 days | D.W. | 0.335 | 0.0006 | 0.334 | 0.336 | 4244.751 | 0.000 |
| | | Pepsi | 0.341 | 0.0008 | 0.34 | 0.342 | | |
| | | Tea | 0.355 | 0.0010 | 0.353 | 0.356 | | |
| | | Cigarette smoke | 0.373 | 0.0007 | 0.372 | 0.374 | | |

**Table 2: Difference in the amounts of light absorption according to the staining materials of brackets bonded with Enlight, Resilience and Transbond adhesives.**

| Adhesive | Media | | 1 day | | 7 days | | 14 days | |
|---|---|---|---|---|---|---|---|---|
| | | | Mean Difference | p-value | Mean Difference | p-value | Mean Difference | p-value |
| Resilience | D.W. | Pepsi | 0.0005 | 0.236 | -0.005 | 0.000 | -0.0091 | 0.000 |
| | | Tea | -0.0153 | 0.000 | -0.0208 | 0.000 | -0.0281 | 0.000 |
| | | Cigarette smoke | -0.0206 | 0.000 | -0.0394 | 0.000 | -0.0492 | 0.000 |
| | Pepsi | Tea | -0.0158 | 0.000 | -0.0158 | 0.000 | -0.019 | 0.000 |
| | | Cigarette smoke | -0.0211 | 0.000 | -0.0344 | 0.000 | -0.0401 | 0.000 |
| | Tea | Cigarette smoke | -0.0053 | 0.000 | -0.0186 | 0.000 | -0.0211 | 0.000 |
| Enlight | D.W. | Pepsi | 0.0006 | 0.129 | -0.0009 | 0.016 | -0.002 | 0.000 |
| | | Tea | -0.0035 | 0.000 | -0.0077 | 0.000 | -0.0152 | 0.000 |
| | | Cigarette smoke | -0.0106 | 0.000 | -0.0206 | 0.000 | -0.0254 | 0.000 |
| | Pepsi | Tea | -0.0041 | 0.000 | -0.0068 | 0.000 | -0.0132 | 0.000 |
| | | Cigarette smoke | -0.0112 | 0.000 | -0.0197 | 0.000 | -0.0234 | 0.000 |
| | Tea | Cigarette smoke | -0.0071 | 0.000 | -0.0129 | 0.000 | -0.0102 | 0.000 |
| Transbond | D.W. | Pepsi | 0.0007 | 0.147 | -0.0023 | 0.000 | -0.0058 | 0.000 |
| | | Tea | -0.0049 | 0.000 | -0.0105 | 0.000 | -0.0196 | 0.000 |
| | | Cigarette smoke | -0.0158 | 0.000 | -0.028 | 0.000 | -0.0379 | 0.000 |
| | Pepsi | Tea | -0.0056 | 0.000 | -0.0082 | 0.000 | -0.0138 | 0.000 |
| | | Cigarette smoke | -0.0165 | 0.000 | -0.0257 | 0.000 | -0.0321 | 0.000 |
| | Tea | Cigarette smoke | -0.0109 | 0.000 | -0.0175 | 0.000 | -0.0183 | 0.000 |

**Table 3: Descriptive statistics of light absorption and duration difference in each media for the brackets bonded with Resilience, Enlight and Transbond adhesives.**

| Adhesives | Media | Duration | Descriptive statistics | | | | Duration difference d.f.=29 | |
|---|---|---|---|---|---|---|---|---|
| | | | Mean | S.D. | Min. | Max. | F-test | p-value |
| Resilience | D.W. | 1 day | 0.35 | 0.0007 | 0.349 | 0.351 | 3.784 | 0.360 |
| | | 7 days | 0.351 | 0.0014 | 0.35 | 0.353 | | |
| | | 14 days | 0.351 | 0.0014 | 0.35 | 0.353 | | |
| | Pepsi | 1 day | 0.350 | 0.0011 | 0.348 | 0.351 | 233.820 | 0.000 |
| | | 7 days | 0.356 | 0.0014 | 0.355 | 0.359 | | |
| | | 14 days | 0.360 | 0.0008 | 0.359 | 0.362 | | |
| | Tea | 1 day | 0.365 | 0.0009 | 0.364 | 0.367 | 324.283 | 0.000 |
| | | 7 days | 0.372 | 0.0015 | 0.37 | 0.374 | | |
| | | 14 days | 0.379 | 0.0012 | 0.378 | 0.381 | | |
| | Cigarette smoke | 1 day | 0.371 | 0.0010 | 0.369 | 0.372 | 2323.433 | 0.000 |
| | | 7 days | 0.391 | 0.0011 | 0.39 | 0.393 | | |
| | | 14 days | 0.401 | 0.0010 | 0.399 | 0.402 | | |
| Enlight | D.W. | 1 day | 0.354 | 0.0008 | 0.353 | 0.355 | 4.235 | 0.250 |
| | | 7 days | 0.355 | 0.0006 | 0.354 | 0.356 | | |
| | | 14 days | 0.355 | 0.0006 | 0.354 | 0.356 | | |
| | Pepsi | 1 day | 0.354 | 0.0010 | 0.352 | 0.355 | 40.433 | 0.048 |
| | | 7 days | 0.356 | 0.0007 | 0.355 | 0.357 | | |
| | | 14 days | 0.357 | 0.0008 | 0.356 | 0.358 | | |
| | Tea | 1 day | 0.358 | 0.0007 | 0.357 | 0.359 | 407.920 | 0.000 |
| | | 7 days | 0.363 | 0.0010 | 0.361 | 0.364 | | |
| | | 14 days | 0.370 | 0.0012 | 0.369 | 0.372 | | |
| | Cigarette smoke | 1 day | 0.365 | 0.0008 | 0.364 | 0.366 | 1077.300 | 0.000 |
| | | 7 days | 0.376 | 0.0008 | 0.375 | 0.377 | | |
| | | 14 days | 0.381 | 0.0007 | 0.38 | 0.382 | | |
| Transbond | D.W. | 1 day | 0.335 | 0.0006 | 0.334 | 0.336 | 0.802 | 0.459 |
| | | 7 days | 0.335 | 0.0006 | 0.334 | 0.336 | | |
| | | 14 days | 0.335 | 0.0006 | 0.334 | 0.336 | | |
| | Pepsi | 1 day | 0.334 | 0.0016 | 0.332 | 0.336 | 70.796 | 0.000 |
| | | 7 days | 0.338 | 0.0013 | 0.335 | 0.339 | | |
| | | 14 days | 0.341 | 0.0008 | 0.34 | 0.342 | | |
| | Tea | 1 day | 0.340 | 0.0006 | 0.339 | 0.341 | 891.208 | 0.000 |
| | | 7 days | 0.346 | 0.0007 | 0.345 | 0.347 | | |
| | | 14 days | 0.355 | 0.0010 | 0.353 | 0.356 | | |
| | Cigarette smoke | 1 day | 0.351 | 0.0011 | 0.349 | 0.352 | 1829.081 | 0.000 |
| | | 7 days | 0.363 | 0.0006 | 0.362 | 0.364 | | |
| | | 14 days | 0.373 | 0.0007 | 0.372 | 0.374 | | |

**Table 4: Difference in the amounts of light absorption according to the immersion days of sapphire bracket in the staining media.**

| Adhesives | Duration | | Pepsi | | Tea | | Cigarette smoke | |
|---|---|---|---|---|---|---|---|---|
| | | | Mean difference | p-value | Mean difference | p-value | Mean difference | p-value |
| Resilience | 1 day | 7 days | -0.0068 | 0.000 | -0.0068 | 0.000 | -0.0201 | 0.000 |
| | | 14 days | -0.0109 | 0.000 | -0.0141 | 0.000 | -0.0299 | 0.000 |
| | 7 days | 14 days | -0.0041 | 0.000 | -0.0073 | 0.000 | -0.0098 | 0.000 |
| Enlight | 1 day | 7 days | -0.0023 | 0.040 | -0.005 | 0.041 | -0.0108 | 0.000 |
| | | 14 days | -0.0034 | 0.011 | -0.0125 | 0.000 | -0.0156 | 0.000 |
| | 7 days | 14 days | -0.0011 | 0.042 | -0.0075 | 0.035 | -0.0048 | 0.000 |
| Transbond | 1 day | 7 days | -0.0033 | 0.000 | -0.0059 | 0.000 | -0.0125 | 0.000 |
| | | 14 days | -0.0068 | 0.000 | -0.015 | 0.000 | -0.0224 | 0.000 |
| | 7 days | 14 days | -0.0035 | 0.000 | -0.0091 | 0.000 | -0.0099 | 0.000 |

## DISCUSSION

The spread and strength of staining are dependent on the type, amount and duration of exposure to a staining agent [19].

The discoloration effect of cigarette might be correlated with its components. There are different components which can cause this discoloration, such as coffee, sugars, cocoa, nicotine, and tar. Nicotine, present in a high concentration in the tobacco leaves, can produce salts with acids that are generally water soluble and can be absorbed by brackets and adhesive material. Tar is a greasy black liquid that might establish the adhesives and cause their discoloration and this comes in accordance with the findings reported by Khazil [20] Wasilewski et al. [21] and Alandia-Roman et al. [22].

The discoloration effects of tea were due to the presence of Tannin or tannic acid and caffeine. Tannic acid can produce complexes not soluble in water with caffeine; these complexes may deposit at the surfaces of the bracket and cause the discoloration. This agrees with the results of Khazil [20] and Hersek et al.[23].

The discoloration effects of Pepsi are associated with the presence of caramel artificial coloring. The synthetic colorants present in Pepsi have a slight discoloration effect on brackets than normal colorants present in cigar and tea and this comes in agreement with Khazil [20].

The degree of discoloration of the materials is affected by many factors such as the type, the media, and the time of storage [24] because all types of adhesive used showed color change in all media with time. The time of storage was taken for the purpose of exposing the brackets to severe conditions to evaluate the degree of discoloration; after this time, there is a tendency towards saturation [25,26].

Deposition of colorant molecules on the resin matrix with time causes the weakening of the resin matrix due to the effect of water, which is a softener of plastics with continuous deposition of the staining materials and chemical degradation of the material surface.

## CONCLUSION

1. Cigarette smoke was the tested medium that had the most influence on the color stability in relation to the light cure adhesive alongside the sapphire ceramic brackets, then tea and lastly Pepsi with non-significant effect of distilled water.
2. The time of immersion increasingly affected the color stability in relation to the adhesive materials alongside the sapphire ceramic brackets with the greatest activity noticed at an interval of fourteen days.

**Conflict of interest:** None.

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**المستخلص**

الهدف من البحث: لقد ازدادت الحاجة لجمالية افضل اثناء علاج الاسنان التقويمي مما دفع اطباء تقويم الاسنان لاستعمال مواد تقويم الاسنان التجميلية (الاسلاك والحاصرات بالإضافة الى الاشرطة المطاطية). انتجت الحاصرات التقويمية التجميلية من انواع مختلفة من المواد، والحاصرات التقويمية الخزفية (ceramic) هي نوع من انواع الحاصرات التقويمية التجميلية ويبقى ثبات لونها هو الشغل الشاغل لكل من الاطباء والمرضى. صممت الدراسة لمقارنة التأثيرات الصبغية لثلاثة مواد مختلفة (البيبسي والشاي الأسود ودخان السجائر) وتأثير الوقت على استقرار لون حاصرات التقويم الخزفية المرتبطة مع ثلاثة أنواع من المواد اللاصقة الضوئية التصلب (Resilience, Enlight and Transbond)

المواد والطرق:تكونت هذه الدراسة من ثلاثمائة وستون حاصرة تقويمية ياقوتية , تم تقسيم هذه الحاصرات وفقا لمواد الربط الى ثلاث مجموعات رئيسية تتكون كل مجموعة من مائة وعشرون حاصرة تقويمية وثم قسمت كل مجموعة الى اربع مجاميع فرعية وفقا لمواد الغمر(الماء المقطر، الشاي الاسود ,البيبسي ودخان السجائر) بواقع ثلاثون حاصرة لكل منهم ثم كل مجموعة الى عشرة حاصرات حسب الفترة الزمنية للغمر (يوم واحد, سبعة ايام واربعة عشر يوما) في درجة حرارة 37م باستعمال الحاضن .تم استخدام الاشعة الطيفية المرئية فوق البنفسجية (Shimadzu, UV -1800)لإجراء اختبار امتصاص الضوء. تم استخدام العملية الاحصائية(ANOVA) و (LSD)لتحديد تأثير المواد الملونة.

النتائج: لقد وجد ان دخان السجائر هو اقوى المواد الملونة يليه الشاي وثم البيبسي.التاثير الصبغي لجميع المواد الملونة على لون الحاصرات المرتبطة مع جميع انواع المواد اللاصقة الضوئية التصلب يزداد مع زيادة وقت الغمر.

الاستنتاجات:ان تعاون المريض يجب ان يؤخذ بنظر الاعتبار عند استخدام الحاصرات التقويمية الخزفية كذلك يجب توجيه المرضى بتقليل استهلاك المشروبات الملونة.